USE OF WASTES FOR FUELS AND CHEMICALS

Robert Clyde
Clyde Engineering, POB 740644
New Orleans, LA 70174

KEYWORDS: Soil, Fungi, Toxic metals

INTRODUCTION

Fibers from old cardboard boxes have high surface area for immobilization of cells which can degrade spilled fuels and produce other chemicals. When Celite is entrapped in the fibers, even more area is provided. A device for supplying oxygen quickly to cells is described.

SOILS AND LAGOONS

Shulman (1) describes how the military has contaminated soils in many parts of the world with jet fuel and TNT. Wood preserving sites have also contaminated soils with chlorinated compounds. These toxic materials are getting into drinking water. White rot fungus degrades these toxic materials but it needs air to grow. When grown on sawdust and buried, it doesn't do a good job for lack of air even when tilled once a week, but when grown on old cardboard boxes, air is entrapped in the corrugations. Landfills consist of 12% cardboard boxes (2) so these are readily available. White rot fungus is sensitive to larger amounts of TNT (3) but on the inside of the corrugations it is protected. The boxes can also be weighted and put into lagoons. A device for putting fungi on boxes is shown in Fig. 2

Supplying air or oxygen for growing fungi is a problem because of low solubility (about 10 ppm). When holes are put in the valleys (Fig.1) of the corrugations and rotated in a half full device, liquid is carried up into the vapor space and falls down through the holes. Mass transfer to droplets is 10-15 times that to a flat surface (4). A US patent (5) covers cells on rotating fibers.

TAXOL FOR CANCER

Taxol can be obtained from the bark of a yew tree but this kills the tree which grows very slowly. Scientists in Montana (6) have found a fungus that produces taxol. In the same article, the National Cancer INstitute has said it has "tremendous implications" for taxol production and Prof. Demain from MIT has said a problem would be to supply oxygen. A device as described in the previous section would supply oxygen much faster. Many women die of breast cancer and taxol is effective against other cancers too.

TOXIC METALS

Lead and six valent chromium are very toxic. Over 100 cities exceed the limit of 15 ppb of lead. When Zymomonas mobilis was grown on Tyvek fiber from DuPont, it removed lead and chromium in a few seconds. A control with nutrient but no Zymomonas did nothing. Large amounts of metals were removed and small amounts also (21 ppb to 3). Lead was analyzed with a Hitachi Z-8100 polarized Zeeman atomic absorption spectrometer with a graphite furnace. A lab corrugator has been made from an old washing machine wringer so other fibers can be corrugated. Patent 4,530,763 describes uranium removal. For valuable metals like silver, brushes between the discs remove the cells as in patent 4,600,694.

ETHANOL

Old cars and trucks still use leaded gasoline but ethanol has high octane and doesn't need lead. Old newspapers can be hydrolyzed to sugar and the sugar fermented to ethanol in 10-15 minutes as described by Clyde (7). Wayman (8) describes this as "remarkable." Bringi and Dale (9)put yeast on a single fiberglas disc and got "high rates of mass transfer...at low agitator speeds." They rotated at 90 rpm but we have found that 20-30 works well so less power is used for agitation. Ingram (10) puts the Zymomonas gene into E.coli so cellulose can be fermented. E.coli grows on fibers too. Old newspapers can be alternated with plastic (similar to the grooves in the ceiling below fluorescent lights) as in Fig. 2. There are health problems with MTBE. It gets into the blood.

CALCIUM MAGNESIUM ACETATE

Salt causes much damage to roads and bridges. CMA can be made with Clostridium on rotating fibers (11). Mathews makes calcium magnesium propionate (12)

COAL

Beer at MIT (13) sprays CMA into burning coal to remove most of the sulfur. Clostridium also converts syn gas to chemicals.

RICE HULLS

Rice hulls are wasted but can be used for growing cells to degrade chemicals or produce chemicals.

LACTIC ACID

Fast food containers are filling up landfills. Lactic acid can be made with a rotary biological contactor half full with air in the top. Polymers of lactic acid are biodegradable.

OTHER APPLICATIONS

Pseudomonas putida grows on fibers as in example 6 of patent 4,530,763. At a meeting of the American Society of Microbiol. in New Orleans, Jackson (talk Q216) degraded toluene,Frackman removed cadmium (Q78) and Babu degraded cyanide (Q312). When an RBC with circular discs is rotated and a light shone in the top, the light hits a thin moving film as in patent 4,446,236. In other photo reactors, colored solution blocks the light. Titania can be entrapped in the fibers. Drops are also made from polyurethane foam as in patent 4,333,893. Scientists at Tufts University gave talk 151c at the Miami AIChE meeting describing putting nutrient down between small polyester discs in a zig zag fashtion as in Fig. 3 and a well known company in New Jersey does the same. When cells are immobilized on rotating discs, however, the nutrient makes a large circle before going through holes to the next disc as in Fig.4.

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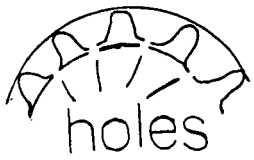

Fig.1

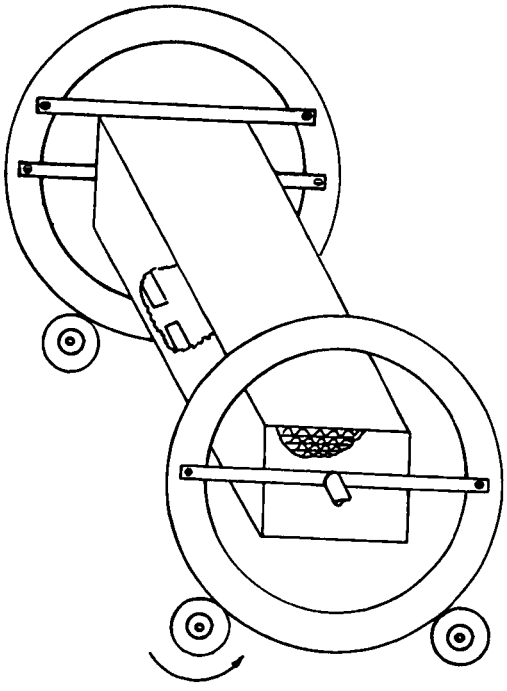

Fig.2

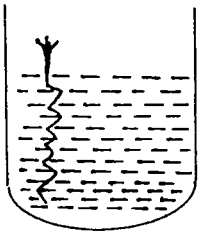

Fig. 3

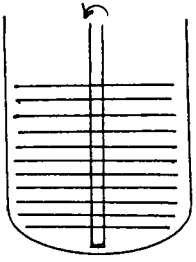

Fig. 4